

# NASA TECH BRIEF

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### New Tooth Enamel From Brushite Crystals

The more familiar method of repairing teeth that are chipped or have cavities is with amalgam or porcelain fillings. The filled teeth surfaces, however, have a different composition and appearance than the actual tooth enamel. Another, more recently developed technique, is to chemically reconstruct the damaged enamel in the mouth.

Recent experiments indicate that an appropriate nutrient gel solution could be used to precipitate brushite ( $\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$ ), which (at basic pH values) becomes hydroxyapatite [ $\text{Ca}_5(\text{PO}_4)_3(\text{OH})$ ], the mineral found in bones and teeth. The gel can be made from sodium metasilicate and phosphoric acid, or gelatin, or other organic materials that polymerize in the presence of an acid to give a gelatinous medium.

The enamel could be reconstructed around a filling as follows. First the affected tooth area is cleaned and filled as in the standard treatment. Next the surface on which the enamel is to be grown is roughened to form crystal-growth sites for the hydroxyapatite. The nutrient gel solution is applied and covered with a supersaturated solution of a highly soluble calcium salt such as  $\text{Ca}_3(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ . A temporary cap is placed over the tooth.

Calcium ions from the supersaturated solution slowly diffuse through the gel, reacting with the phosphate ions to form brushite. The catalytic effect of the roughened tooth surface causes the brushite to be preferentially formed on that area. The rate of brushite formation is slow, being controlled by calcium ion diffusion through the gel. This allows the growth of

sizeable crystals on the tooth surface. Because the gel pH is basic, the brushite will ultimately convert to hydroxyapatite.

After several days, the cap should be removed and the tooth surface polished. The entire procedure may be repeated as many times as necessary to achieve the desired tooth surface.

#### Note:

Additional details are contained in U.S. Patent No. 3,679,360, which is available from:

Commissioner of Patents  
U.S. Patent Office  
Washington, D. C. 20231  
Single document price \$0.50

#### Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,679,360). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

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